

Analysis of Difficulties in the Completion of the Comparable Product Cost Reduction Plan Based on Formula Derivation

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Abstract

Cost statements are important documents that reflect cost information. By analyzing cost statements, problems existing in cost management can be identified, thereby prompting the timely adoption of improvement measures. A difficulty in cost analysis lies in the in-depth analysis of the completion of the comparable product cost reduction plan. There are many problems in the teaching process; therefore, this paper mainly analyzes the difficulty of the completion of the comparable product cost reduction plan from the source, using two perspectives: the chain substitution method and the simplified calculation of the chain substitution method, based on the formula derivation process. This helps to better understand the completion of the comparable product cost reduction plan, further identify problems in the enterprise's product cost management, and thus improve the enterprise's cost management.

Keywords

Cost Statement, Chain Substitution Method, Comparable Product Cost Reduction Plan, Simplified Calculation

1. Introduction

As a value category, cost exists objectively in the socialist market economy. Strengthening cost management and striving to reduce costs is not only crucial for enterprises to improve their own economic benefits but also of great significance for promoting the growth of macroeconomic benefits of the national economy as a whole (Yu, Li, & Zhang, 2024). The analysis of product costs is a key link in cost management, and the analysis of the completion of the comparable product cost reduction plan is a complex part of it.

Comparable products refer to products that an enterprise has formally put into production in history and have complete cost data available for comparative analysis. The chain substitution method is often used to analyze the completion of the comparable product cost reduction plan. When using the chain substitution method to analyze the implementation effect of the comparable product cost reduction plan, the object of analysis is the deviation degree between the actual reduction amount and the expected reduction amount of the comparable product cost reduction amount relative to the total cost of the previous year. In practical teaching activities, using the chain substitution method to analyze the completion of the comparable product cost reduction plan is often regarded as a difficulty by students, because it involves complex analysis affected by multiple factors. This part of the content is particularly difficult to understand in cost statement analysis, so it is necessary to analyze this key and difficult content.

2. Cost Statements

Cost statements are reporting documents used to disclose product costs, period expenses, and other related cost information. According to the content reflected, cost statements can be divided into statements reflecting product cost conditions, statements reflecting various expense expenditures, and statements reflecting special costs. When analyzing cost statements reflected by product types, the difficulty lies in comparing and in-depth analyzing the achievement of the implementation of the comparable product cost reduction plan with the expected goals.

3. Chain Substitution Method

When a comprehensive economic indicator is affected by several factors, the chain substitution method is usually used to determine the degree of influence of a certain influencing factor.

Identify the various factors affecting the change of the indicator based on the analysis of the indicator; Arrange the substitution order of each influencing factor according to certain principles; Calculate the benchmark value of the indicator in accordance with the arranged order; Replace the benchmark value with the actual value of each factor in turn, and retain the actual value after each replacement; Then, by calculating the difference between the result obtained after each replacement and the result of the previous time, the degree of influence of each factor on the change of the indicator can be measured; Subsequently, check the algebraic sum of these influence degrees with the total difference of the indicator change to ensure that they are consistent.

The chain substitution method is expressed by the formula as follows:

Assume that an economic indicator X is affected by three factors: A , B , and C .

Calculate X_0 and X_1 , which are the base period indicator and the actual indicator respectively.

$$X_0 = A_0 \times B_0 \times C_0$$

$$X_1 = A_1 \times B_1 \times C_1$$

Use the chain substitution method for analysis, and determine D as the analysis object ($D = X_1 - X_0$).

Secondly, determine the substitution order of A , B , and C .

1) Take the base number as the calculation basis: $X_0 = A_0 \times B_0 \times C_0$ ①

2) Replace A_0 , B_0 , C_0 with A_1 , B_1 , C_1 in sequence, and obtain the following results:

② $X_2 = A_1 \times B_0 \times C_0$

③ $X_3 = A_1 \times B_1 \times C_0$

④ $X_1 = A_1 \times B_1 \times C_1$

3) ② - ① is the degree of influence of the change of factor A on X .

4) ③ - ② is the degree of influence of the change of factor B on X .

5) ④ - ③ is the degree of influence of the change of factor C on X .

6) The algebraic sum of the influence degrees of each factor change is the analysis object.

The algebraic sum of the influence degrees of each factor change, calculated using the results in the above formula, $(\textcircled{2} - \textcircled{1}) + (\textcircled{3} - \textcircled{2}) + (\textcircled{4} - \textcircled{3}) = (\textcircled{4} - \textcircled{1})$.

④ is equal to $X_1 = A_1 \times B_1 \times C_1$, and ① is equal to $X_0 = A_0 \times B_0 \times C_0$.

④ - ① = $(X_1 = A_1 \times B_1 \times C_1) - (X_0 = A_0 \times B_0 \times C_0) = X_1 - X_0 = D$.

Therefore, the analysis object is equal to the algebraic sum of the changes of each factor.

4. Research Hypothesis

In this study, when analyzing the cost reduction plan for comparable products, it is assumed that during the analysis period, the market price of products remains stable without the impact of inflation, and the prices of factors such as raw material procurement costs and labor costs fluctuate. At the same time, it is assumed that the production technology level, production process and production efficiency remain unchanged, and the basic standards such as raw material consumption quota and working hour quota do not change. In addition, it is assumed that the product structure, production batch and production-sales balance remain stable, and there is no major adjustment of production factors or sudden changes in the external market environment. These assumptions ensure the comparability and simplicity of cost analysis, but also make the analysis results only applicable to short-term decision-making reference with a relatively stable external environment. When there are price fluctuations, technological innovations or significant changes in production scale in actual operation, their applicability needs to be reassessed.

5. Analysis of the Completion of the Comparable Product Cost Reduction Plan

5.1. Example

Assume that the cost reduction situation of two comparable products (Product A and Product B) of Enterprise C is as shown in **Table 1**.

Table 1. Comparable product cost reduction table (Unit: Yuan).

Product Name	Output		Unit Cost			Total Cost of the Current Year		Total Cost of the Current Year		
	P_1	P_2	C_0	C_1	C_2	$P_1 \times C_0$	$P_1 \times C_1$	$P_2 \times C_0$	$P_2 \times C_1$	$P_2 \times C_2$
Product A	200	300	100	95	93	20,000	19,000	30,000	28,500	27,900
Product B	400	500	50	58	55	20,000	23,200	25,000	29,000	27,500
Subtotal						40,000	42,200	55,000	57,500	55,400

5.2. Definition of Symbols Related to Comparable Product Cost Analysis, Calculation of Relevant Indicators and Implications of Results

The meanings of relevant symbols in the analysis of comparable product costs are shown in **Table 2**.

Table 2. Definition of symbols for comparable product cost analysis.

Symbol Name	Meaning
P_1	This Year's Planned Output
P_2	This Year's Actual Output
C_0	Last Year's Actual Unit Cost
C_1	This Year's Planned Unit Cost
C_2	This Year's Actual Unit Cost

The relevant calculations and result interpretations of cost reduction amount are shown in **Table 3**.

Table 3. Table of relevant indicators calculation and result interpretation for cost reduction amount.

Indicator Name	Calculation Process	Result Interpretation	Cost Variation
Planned Reduction Amount	Planned Reduction Amount = Actual Cost of Last Year – Planned Total Cost of This Year (Planned Output)	“+” Planned cost is lower than the actual cost of last year	Cost Reduction
		“-” Planned Cost is Higher Than Last Year's Actual Cost	Cost Increase
Actual Reduction Amount	Actual Reduction Amount = Actual Total Cost of Last Year – Actual Total Cost of This Year (Actual Output)	“+” This Year's Actual Total Cost is Lower Than Last Year's Actual Total Cost	Cost Reduction
		“-” This Year's Actual Total Cost is Higher Than Last Year's Actual Cost	Cost Increase
Actual Variance from the Plan	Actual Variance from the Plan = Actual Reduction Amount – Planned Reduction Amount	“+” The Actual Reduction Amount is lower than the Planned Reduction Amount	Cost Reduction
		“-” Actual Reduction Amount is higher than the Planned Reduction Amount	Cost Increase

5.3. Calculation of Relevant Analysis Indicators

Planned Reduction Amount of Comparable Products

$$= \sum P_1 \times C_0 - \sum P_1 \times C_1 = 40000 - 42200 = -2200$$

Planned cost reduction rate

$$= \frac{\sum P_1 \times C_0 - \sum P_1 \times C_1}{\sum P_1 \times C_0} \times 100\% = \frac{40000 - 42200}{40000} \times 100\%$$

$$= \frac{-2200}{40000} \times 100\% = -5.5\%$$

Actual Reduction Amount of Comparable Products

$$= \sum P_2 \times C_0 - \sum P_2 \times C_2 = 55000 - 55400 = -400$$

Actual cost reduction rate

$$= \frac{\sum P_2 \times C_0 - \sum P_2 \times C_2}{\sum P_2 \times C_0} \times 100\% = \frac{55000 - 55400}{55000} \times 100\%$$

$$= \frac{-400}{55000} \times 100\% = -0.7273\%$$

5.4. Determination of the Analysis Object

Prepare **Table 4** based on the above calculation results.

Table 4. Completion status table of comparable product cost reduction plan (Unit: Yuan).

Comparable Products	Planned Reduction Indicator		Actual Reduction Indicators	
	Planned Reduction Amount	Planned Reduction Rate	Actual Reduction Amount	Actual Reduction Rate
Product A	1000	5%	2100	7%
Product B	-3200	-16%	-2500	-10%
Subtotal	-2200	-5.5%	-400	-0.7273%

It can be seen from the calculation results in **Table 4** that the calculation process of the planned reduction amount of comparable products is as follows: Calculate the result of multiplying the actual average unit cost of the previous year by the planned output, and calculate the result of multiplying the planned unit cost of the current year by the planned output of the current year. The difference obtained by subtracting the latter result from the former is the planned reduction amount of comparable products. If the difference is greater than 0, it indicates the amount by which the cost is planned to be reduced in the current year compared with the previous year. For example, if the calculated result in this question is a positive 2200 yuan, it means that the cost is planned to be reduced by 2200 yuan in the current year compared with the previous year. The actual reduction amount of comparable products is understood in the same way. However, in this example, the planned reduction amount of comparable products is -2200 yuan, and the actual reduction amount is -400 yuan. In the actual teaching process, students do

not understand why the reduction amount is negative. With changes in production conditions and technical conditions, the cost level shows a constantly changing trend, but it does not always show a downward trend of costs; there may be cases of cost reduction or cost increase. Under the condition that the planned output and other factors remain unchanged, the planned reduction amount of comparable products is the cost of the previous year minus the planned cost of the current year. A reduction of -2200 yuan can be understood as the cost increase in the current year compared with the previous year should not exceed 2200 yuan; the actual reduction amount is -400 yuan, which means that the actual cost in the current year has increased by 400 yuan compared with the previous year. Then, has the enterprise completed the task of the cost reduction plan?

Calculate the difference between the actual and the planned:

$$\begin{aligned} & \text{Difference in cost reduction amount} \\ &= \text{Actual reduction amount} - \text{Planned reduction amount} \\ &= -400 - (-2200) = 1800 \text{ yuan} \end{aligned}$$

$$\begin{aligned} & \text{Difference in cost reduction rate} \\ &= \text{Actual reduction rate} - \text{Planned reduction rate} \\ &= -0.7273\% - (-5.5\%) = 4.7727\% \end{aligned}$$

In terms of the reduction amount, from the perspective of the difference between the actual reduction amount and the planned reduction amount, the planned reduction amount means that the cost increase compared with the previous year should not exceed 2200 yuan. From the data of the actual reduction amount, the cost increase compared with the previous year is only 400 yuan, which does not exceed the 2200 yuan set in the plan. The actual reduction is 1800 yuan more than the planned reduction, so the comparable products have completed the cost reduction plan. The planned increase in the reduction rate should not exceed 5.5%, and the actual reduction rate is -0.7273%, that is, the actual increase is only 0.7273%, which does not exceed the planned 5.5%. The actual reduction rate is 4.7727% lower than the planned reduction rate, indicating that the cost reduction rate has also completed the cost reduction plan.

5.5. Analysis of the Completion of the Comparable Product Cost Reduction Plan

From the calculation of the above analysis object, it can be seen that the comparable products have completed the cost reduction plan. However, the comparable product cost reduction amount is a comprehensive economic indicator, and its influencing factors mainly include: product output, product variety composition, and product unit cost (Enterprise Product Cost Accounting Editorial Committee, 2024). Then, what is the degree of influence of a certain factor on the comprehensive economic indicator? That is, in the process of completing the cost reduction plan, which of the three factors plays a greater role? The usual approach is to use the chain substitution method to analyze and determine the degree of influence of each influencing factor. Compared with other difference analysis methods, the

core of the sequential substitution method lies in its logic of “successive substitution and serial calculation”. This logic enables it to systematically decompose the total differences in cost reduction amount and cost reduction rate into the individual impact amounts of various influencing factors (such as output volume, product mix, and unit cost). In this way, it achieves accurate tracing of the causes of differences, rather than merely staying at the superficial comparison of total differences (Wang, 2015).

5.5.1. Influence of Product Output Change

Under the condition that the two factors of product variety composition and unit cost remain unchanged, what kind of result will be caused only when the output changes?

First, from the calculation perspective, assuming that other conditions remain unchanged, the actual output increases by 20% on the basis of the planned output. That is, after the output of Product A and Product B each increases by 20%, the output of Product A and Product B is 240 units and 480 units respectively. Under the condition that the output is expected to increase by 20%, the cost reduction amount is calculated based on the data given in the above example:

$$\begin{aligned} & \text{Cost reduction amount} \\ &= \sum P_1 \times 120\% \times C_0 - \sum P_1 \times 120\% \times C_1 \\ &= 40000 \times 120\% - 42200 \times 120\% \\ &= 48000 - 50640 = -2640 \text{ yuan} \end{aligned}$$

$$\begin{aligned} & \text{Reduction Rate of Comparable Products} \\ &= \frac{\sum P_1 \times 120\% \times C_0 - \sum P_1 \times 120\% \times C_1}{\sum P_1 \times 120\% \times C_0} \times 100\% \\ &= \frac{48000 - 50640}{48000} \times 100\% = -5.5\% \end{aligned}$$

It can be seen that when the output increases by 20%, only the reduction amount changes, and the reduction rate remains unchanged at -5.5% .

Second, from the perspective of formula derivation under the condition that the output increases by 20%:

$$\begin{aligned} & \text{Reduction Rate of Comparable Products} \\ &= \frac{\sum P_1 \times 120\% \times C_0 - \sum P_1 \times 120\% \times C_1}{\sum P_1 \times 120\% \times C_0} \times 100\% \end{aligned}$$

If the 120% in the above formula is eliminated, then under the condition that the output increases by 20%

$$\begin{aligned} & \text{Reduction Rate of Comparable Products} \\ &= \frac{\sum P_1 \times C_0 - \sum P_1 \times C_1}{\sum P_1 \times C_0} \times 100\% \\ &= \frac{\sum P_1 \times C_0 - \sum P_1 \times C_1}{\sum P_1 \times C_0} \times 100\% \end{aligned}$$

This formula is the same as the calculation of the planned reduction rate. From

this result, it can be seen that under the premise that the planned variety composition and the planned unit cost remain unchanged, the planned reduction rate of comparable products is completely consistent with the reduction rate caused by the output change. The change in output has no impact on the reduction rate, but the reduction amount changes. It should be particularly noted here, In the example question, the provided figure of 55,000 yuan represents the total cost of the previous year, calculated based on the actual output and actual variety composition; while the figure of 57,500 yuan represents the planned cost of the current year, calculated based on the actual output and actual variety composition, which can be reflected through the calculation and analysis process later. A significant feature of the change in output alone is that its change will not cause a change in the cost reduction rate, but only a change in the cost reduction amount. Based on this, the following formula can be used to calculate the comparable product reduction rate when the actual output replaces the planned output:

$$\begin{aligned} & \frac{\sum \text{Cost reduction amount under actual output, planned variety composition, and planned unit cost}}{\sum \text{Actual Output} \times \text{actual average unit cost of the previous year}} \times 100\% \\ &= \frac{\sum \text{Cost reduction amount under actual output, planned variety composition, and planned unit cost}}{55000(\sum P_2 \times C_0)} \\ &= -5.5\% \\ & \sum \text{Cost reduction amount under actual output, planned variety composition, and planned unit cost} \\ &= 55000 \times (-5.5\%) = -3025 \end{aligned}$$

3025 yuan is the reduction amount calculated by replacing the planned output with the actual output, under the condition that both the product mix and unit cost are based on planned data. Subtracting the planned reduction amount of -2200 yuan from -3025 yuan gives -825 yuan, which is the impact of output changes. According to the previous analysis, output changes have no impact on the reduction rate (Lu, 2019).

5.5.2. Influence of Product Variety Composition Change

Different comparable products have different cost reduction rates, and changes in their proportions will also cause corresponding changes in the reduction rate and reduction amount.

$$\begin{aligned} & \text{Reduction amount under actual output, actual variety composition, and planned unit cost} \\ &= \sum P_2 \times C_0 - \sum P_2 \times C_1 = 55000 - 57500 = -2500 \text{ yuan} \end{aligned}$$

$$\begin{aligned} & \text{Reduction rate under actual output, actual variety composition, and planned unit cost} \\ &= \frac{\sum P_2 \times C_0 - \sum P_2 \times C_1}{\sum P_2 \times C_0} \times 100\% = \frac{55000 - 57500}{55000} \times 100\% \\ &= \frac{-2500}{55000} \times 100\% = -4.5455\% \end{aligned}$$

$$\begin{aligned} & \text{Influence of variety composition change on reduction amount} \\ &= -2500 - (-3025) = 525 \text{ yuan} \end{aligned}$$

$$\begin{aligned} &\text{Influence of variety composition change on reduction rate} \\ &= -4.5455\% - (-5.5\%) = 0.9545\% \end{aligned}$$

The influence degree of the variety composition change on the reduction amount can also be directly reflected by the following formula:

$$\begin{aligned} &\text{The Impact Degree of Changes in Product Variety Composition on the Reduction Amount} \\ &= (\sum P_2 \times C_0 - \sum P_2 \times C_1) - \sum P_2 \times C_0 \times (-5.5\%) \\ &= -2500 - 55000 \times (-5.5\%) = -2500 - (-3025) = 525 \end{aligned}$$

5.5.3. Influence of Product Unit Cost Change on Reduction Amount

Reduction amount under actual output, actual variety composition, and actual unit cost

$$= \sum P_2 \times C_0 - \sum P_2 \times C_2 = 55000 - 55400 = -400 \text{ yuan}$$

Reduction Rate of Comparable Products

$$\begin{aligned} &= \frac{\sum P_2 \times C_0 - \sum P_2 \times C_2}{\sum P_2 \times C_0} \times 100\% \\ &= \frac{-400}{55000} \times 100\% = -0.7273\% \end{aligned}$$

Influence of unit cost change on reduction amount

$$= -400 - (-2500) = 2100 \text{ yuan}$$

Influence of unit cost change on reduction rate

$$= -0.7273\% - (-4.5455\%) = 3.8182\%$$

The above calculation results are shown in **Table 5**.

Table 5. Factor analysis and calculation table for the completion of the comparable product cost reduction plan.

Indicator	Reduction Amount (Yuan)	Reduction Rate (%)
① Cost reduction amount under planned output, planned variety composition, and planned unit cost	-2200	-5.5%
② Cost reduction amount under actual output, planned variety composition, and planned unit cost	-3025	-5.5%
② - ① Influence of output change	-825	0
③ Cost reduction amount under actual output, actual variety composition, and planned unit cost	-2500	-4.5455%
③ - ② Influence of product variety composition change	525	0.9545%
④ Cost reduction amount under actual output, actual variety composition, and actual unit cost	-400	-0.7273%
④ - ③ Influence of product unit cost change	2100	3.8182%
Algebraic sum of influences of various factors	1800	4.7727%

6. Analysis of the Completion of the Comparable Product Cost Reduction Plan by the Simplified Calculation Method

It can be seen from the above analysis process that when using the chain substitu-

tion method to analyze comparable products, the process is slightly complex. A simplified method is also used to analyze comparable products.

When using the simplified calculation method for analysis, the first step is to determine how much of the change in the reduction amount is caused by the change in the product unit cost.

$$\begin{aligned}
 & \text{Influence of product unit cost change} \\
 &= \left(\sum \text{actual output} \times \text{actual average unit cost of the previous year} \right. \\
 & \quad \left. - \sum \text{actual output} \times \text{actual unit cost of the current year} \right) \\
 & \quad - \left(\sum \text{actual output} \times \text{actual average unit cost of the previous year} \right. \\
 & \quad \left. - \sum \text{actual output} \times \text{planned unit cost of the current year} \right) \\
 &= \sum \text{actual output} \times \text{actual average unit cost of the previous year} \\
 & \quad - \sum \text{actual output} \times \text{actual unit cost of the current year} \\
 & \quad - \sum \text{actual output} \times \text{actual average unit cost of the previous year} \\
 & \quad + \sum \text{actual output} \times \text{planned unit cost of the current year} \\
 &= \sum \text{actual output} \times \text{planned unit cost of the current year} \\
 & \quad - \sum \text{actual output} \times \text{actual unit cost of the current year} \\
 &= \sum P_2 \times C_1 - \sum P_2 \times C_2
 \end{aligned}$$

In the above calculation formula, $\sum P_2 \times C_1 = 57500$ yuan , $\sum P_2 \times C_2 = 55400$ yuan , and $\sum P_2 \times C_1 - \sum P_2 \times C_2 = 57500 - 55400 = 2100$ yuan , which is the influence amount of the product unit cost change. On this basis, the calculated influence degree on the reduction rate is 3.8182% ($2100 \div 55000$). In the process of formula arrangement, the actual average unit cost of the previous year multiplied by the actual output appears once positive and once negative, which cancels each other out. Therefore, the influence degree of the product unit cost change on the reduction amount can be calculated by multiplying the actual output by the difference between the planned unit cost of the current year and the actual unit cost of the current year. It is particularly important to remind that, unlike the general calculation of cost overrun or savings, where the actual cost is subtracted from the planned cost, the calculation of the influence degree of the product unit cost change on the reduction amount is to multiply the actual output by (the planned unit cost of the current year minus the actual unit cost of the current year), which can be presented through the detailed derivation process of the previous formula.

The change in output does not affect the cost reduction rate. The two factors that affect the cost reduction rate are the variety composition and the unit cost. 3.8182% is the influence degree of the unit cost change. Then, subtracting 3.8182% from 4.7727% gives the influence of the product variety composition change on the reduction rate, which is 0.9545%.

$$\begin{aligned}
 & \frac{\sum \text{Cost reduction amount under actual output, actual variety composition, and planned unit cost}}{\sum \text{actual output} \times \text{actual average unit cost of the previous year} (\sum P_2 \times C_0)} \times 100\% \\
 &= 0.9545\%
 \end{aligned}$$

$$\begin{aligned} & \sum \text{Cost reduction amount under actual output, actual variety composition, and planned unit cost} \\ & = \sum P_2 \times C_0 \times 0.9545\% = 525 \end{aligned}$$

According to the previous analysis, the total difference between the actual and the planned is 1800 yuan, the influence amount of the unit cost is 2100 yuan, and the influence amount of the variety composition change on the cost is 525 yuan. Then, the influence degree of the output change on the cost reduction amount is equal to -825 yuan ($1800 - 2100 - 525$).

From the calculation results of the simplified calculation method and the chain substitution method, the results calculated by the two methods are equal, but the calculation process of the simplified calculation method is obviously simplified. The understanding of this simplified calculation process is based on the understanding of the detailed formula calculation process, and essentially, it is also based on the understanding of the formula calculation of the chain substitution method. However, it should be noted that the core of the simplified calculation method lies in efficiently calculating the impact of individual factors under the assumption that various factors are independent of each other; it does not downplay the interactions between these factors.

7. Conclusion

From the perspective of calculation results, the comparable products have completed the reduction plan. In terms of the reduction amount, the actual reduction is 1800 yuan more than the planned reduction; in terms of the reduction rate, the actual reduction is 4.7727% more than the planned reduction. The main influencing factors are the unit cost and the variety composition, among which the main reduction factor is the reduction of the unit cost. The change in the unit cost causes the actual reduction to be 2100 yuan more than the planned reduction, while the increase in product output causes the actual reduction to be 825 yuan less than the planned reduction. The above analysis uses the chain substitution method. This analysis focuses on the completion of the comparable product cost reduction plan. In the teaching process, this analysis is helpful for students, so as to better conduct cost analysis and strengthen cost management.

Fund Project

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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